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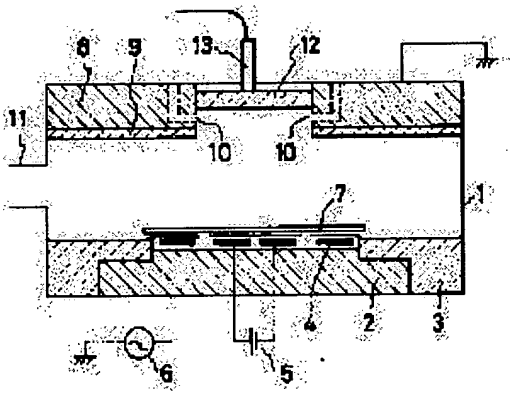
(54) METHOD OF DRY ETCHING AND APPARATUS USED IN SAME

(57)Abstract:

PURPOSE: To provide a method and an apparatus in which fluorocarbon polymer film is deposited on an optical transmission window for observing an emission spectrum of a plasma in order to detect an end point of an etching and a transmission rate is prevented from deteriorating concerning a dry etching method used in a process for etching an SiO2 film serving as a component member of a semiconductor device and an apparatus used in the method.



CONSTITUTION: In a process of a dry etching using a treating gas containing at least C, F and H such as CF4 and H2, etching is performed while the treating gas is sprayed on an optical transmission window 12 for observation of a dry etching apparatus. Also, in the dry etching apparatus using the treating gas containing at least C, F and H such as CF4 and H2, treating gas inlets 10 are formed so as to spray the treating gas on the optical transmission window 12 for observation of the dry etching apparatus. In this case, two or more treating gas inlets 10 can be installed in a point symmetry to the center of a treated substrate 7.

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CLAIMS

[Claim(s)]
[Claim 1] The dry etching method characterized by etching in the process which carries out dry etching to C using the raw gas containing F and H at least, spraying this raw gas on the light-transmission aperture for observation of a dry etching system.
[Claim 2] the raw gas which contains C, and F and H at least -- CF4 H2 it is -- the dry etching method indicated by the claim 1 characterized by things
[Claim 3] The dry etching system characterized by forming the raw-gas inlet in the dry etching system using the raw gas which contains C, and F and H at least so that this raw gas may be sprayed on the light-transmission aperture for observation of a dry etching system.
[Claim 4] The dry etching system indicated by the claim 3 characterized by having two or more inlets of a raw gas, and being arranged to the center of a processed substrate at the point symmetry.
[Claim 5] The dry etching system indicated by the claim 3 or claim 4 to which the light-transmission aperture for observation is characterized by being constituted with a quartz or sapphire.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention -- the manufacturing process of a semiconductor device, especially the composition of a semiconductor device -- it is related with the equipment which uses SiO2 film which is a member for the dry etching method used for the process which **********s, and it
[0002]
[Description of the Prior Art] SiO2 CF4 and CHF3 advantageous to membranous etching in respect of control of the configuration of etching, or a size, CH two F2, C2 F6, and C4 F8 etc. -- the dry etching using the raw gas of the fluorocarbon system containing C, and F and H is adopted widely
[0003] And mass-production-izing and in order to automate, it is indispensable also to an etching system to give the function corresponding to automation of a manufacturing process for the manufacturing process of a semiconductor device, and some methods of detecting the terminal point of etching of a processed film automatically as part of that are proposed.
[0004] The method of observing the emission spectrum in plasma is mentioned to one of the methods which detects the terminal point of etching of a non-processing film. Although the emission spectrum of etching plasma changes with composition and the ratios of etching gas, in order that the element which constitutes a processed film may mix into etching plasma if a processed film **********s even if it uses the same etching gas, the emission spectrum changes.
[0005] By carrying out spectral analysis of the change of this emission spectrum, the terminal point of etching is detectable. Thus, in order to observe [from] the emission spectrum of etching plasma outside an etching system, it is required to prepare the light-transmission aperture which penetrates the wavelength of plasma luminescence in a dry etching system.
[0006] Drawing 3 is outline explanatory drawing of the conventional dry etching system. this drawing -- setting -- 21 -- a container and 22 -- a cathode electrode, and 23 and 31 -- an insulator and 24 -- an electrostatic chuck and 25 -- helium feed hopper and 26 -- helium exhaust port and 27 -- DC power supply and 28 -- a RF generator and 29 -- in an etching gas supply mouth and 33, an etching gas exhaust port and 34 show the quartz aperture, and 35 shows [a wafer and 30 / an anode electrode and 32] the spectroscope probe
[0007] In this conventional dry etching system, the cathode electrode 22 is installed in the container 21 bottom through an insulator 23, the electrostatic chuck 24 is installed on this cathode electrode 22, the anode electrode 30 is installed in the container 21 bottom, and the insulator 31 is formed in the front face.
[0008] And DC power supply 27 are connected to the segment of the electrostatic chuck 24 on the cathode electrode 22, and it adsorbs, and a wafer 29 supplies helium from the helium feed hopper 25, discharges from the helium exhaust port 26, and is reducing the thermal resistance between a wafer 29 and the cathode electrode 22.
[0009] Moreover, supplying etching gas from the etching gas supply mouth 32, and discharging from

the etching gas exhaust port 33, by RF generator 28 connected between the cathode electrode 22 and the anode electrode 30, it plasma-izes and dry etching of the front face of a wafer 29 is carried out.
[0010] Moreover, the quartz aperture 34 is formed in the position distant from the passage of etching gas, and a plasma emission spectrum is observed with the spectroscope probe 35 through this quartz aperture 34.
[0011]
[Problem(s) to be Solved by the Invention] However, it is SiO2 by the conventional dry etching system. Since a fluorocarbon polymerization film would accumulate also on the light-transmission aperture for etching terminal point observation which are some containers, the luminous intensity of plasma luminescence which penetrates an aperture would fall gradually and detection of an etching terminal point would become impossible although a fluorocarbon polymerization film accumulates on a container wall if a film is **********ed, it was indispensable to have washed a light-transmission aperture frequently or to have exchanged them.
[0012] this invention aims at preventing a fluorocarbon polymerization film's accumulating on the light-transmission aperture for observing the emission spectrum of plasma, and transmittance deteriorating in order to detect the terminal point of dry etching.
[0013]
[Means for Solving the Problem] In the dry etching method concerning this invention, the process which etches while spraying this raw gas on the light-transmission aperture for observation of a dry etching system was adopted in the process which carries out dry etching to C using the raw gas containing F and H at least.
[0014] In this case, it is CF4 about the raw gas which contains C, and F and H at least. H2 It can carry out.
[0015] Moreover, in the dry etching system concerning this invention, the composition in which the raw-gas inlet is formed so that this raw gas may be sprayed on the light-transmission aperture for observation of a dry etching system was adopted in the dry etching system using the raw gas which contains C, and F and H at least.
[0016] In this case, two or more inlets of a raw gas can be formed, and it can arrange to a point symmetry to the center of a processed substrate.
[0017] Moreover, a quartz or sapphire can constitute the light-transmission aperture for observation in this case.
[0018]
[Function] If an etching gas inlet is prepared near the light-transmission aperture for observation and it is made to spray etching gas on this transparency aperture like this invention, there is no reduction and deposition of a fluorocarbon polymerization film can be made for there to be nothing.
[0019] Drawing 4 is explanatory drawing of the experiment equipment of the fluorocarbon rate of sedimentation. With the conventional dry etching system shown in drawing 3 , since the structure of the experiment equipment of the fluorocarbon rate of sedimentation shown in this drawing is fundamentally the same, it attaches drawing 3 and a same sign, and it omits explanation. The sign 36 which newly appeared in drawing 4 shows the quartz substrate for a test, and d shows the distance between the etching gas supply mouth 32 and the quartz substrate 36 for a test.
[0020] Using this experiment equipment, it distance d Detached, the quartz substrate 36 for a test has been arranged directly under the etching gas supply mouth 32, dry etching of the wafer 29 was carried out on condition that usual, and the fluorocarbon rate of sedimentation deposited on the quartz substrate 36 for a test was measured.
[0021] Drawing 5 is the related view of the distance from a gas inlet, and the fluorocarbon rate of sedimentation. This drawing shows the relation of the distance of the rate of sedimentation of fluorocarbon and the inlet of etching gas which are deposited on the quartz substrate for a test. About distance [of a gas inlet and a substrate] d (cm), a horizontal axis is [a vertical axis] the rate of sedimentation (A/min).
[0022] The processing conditions in this experiment are CF4. Flow rate 50sccmH2 Flow rate 50sccm

pressure 0.5Torr RF power It was 300W.
[0023] As shown in this drawing, on a quartz substrate, fluorocarbon does not accumulate the point near the gas inlet, but the rate of sedimentation goes up [the distance d of a gas inlet and a substrate] from about 6cm, and the rate of sedimentation goes up rapidly from about 8cm. If this experimental result has the quick rate of flow of etching gas, the fact that fluorocarbon does not accumulate on a quartz substrate is also shown.
[0024] Therefore, CF4 / H2 which are etching gas near the light-transmission aperture for etching terminal point observation If the inlet of gas is especially prepared and it is made to spray etching gas on the light-transmission aperture for etching terminal point surveillance, deposition can be completely prevented for fluorocarbon.
[0025] By preparing two or more etching gas inlets, arranging in the position of a point symmetry to the center of a processed substrate, and spraying toward a center, etching gas can be uniformly diffused in an etching system, and the homogeneity of the configuration after an etch rate and etching can be improved. Moreover, the distribution of etching gas can be adjusted by spraying in the direction which shifted only the predetermined angle from the center of a processed substrate from two or more etching gas inlets arranged in the position of a point symmetry to the center of a processed substrate.
[0026]
[Example] Hereafter, the example of this invention is explained. Drawing 1 is outline explanatory drawing of the dry etching system of one example. this drawing -- setting -- 1 -- a container and 2 -- a cathode electrode, and 3 and 9 -- an insulator and 4 -- an electrostatic chuck and 5 -- DC power supply and 6 -- a RF generator and 7 -- in an etching gas supply mouth and 11, an etching gas exhaust port and 12 show the quartz aperture, and 13 shows [a wafer and 8 / an anode electrode and 10] the spectroscope probe
[0027] In the cathode combination type dry etching system of this example, the cathode electrode 2 is installed in the container 1 bottom through an insulator 3, the electrostatic chuck 4 is installed on this cathode electrode 2, the anode electrode 8 which has opening is installed in the container 1 bottom, the opening is closed by the quartz aperture 12 and the spectroscope probe 13 is arranged on the outside of the quartz aperture 12. Moreover, the insulator 9 which protects the anode electrode 8 from contamination is formed in the front face of the anode electrode 8.
[0028] And high-pressure DC power supply 5 are connected to the segment of the electrostatic chuck 4 on the cathode electrode 2, and the wafer 7 adsorbs. Moreover, two or more etching gas supply mouths 10 are formed around opening of the anode electrode 8, etching gas is blown off from this etching gas supply mouth 10 toward the center of the quartz aperture 12, and it discharges from the etching gas exhaust port 11, and with the 13.56MHz RF power supplied from RF generator 6 connected between the cathode electrode 2 and the anode electrode 8, etching gas is plasma-ized and a wafer 7 is **********ed.
[0029] Drawing 2 is explanatory drawing of the gas inlet of the dry etching system of one example, (A) is the cross section of a gas inlet and (B) is the plan. Moreover, the sign in this drawing is the same as that of what was used in drawing 1 .
[0030] Four gas inlets of the dry etching system of one example are prepared [a processed substrate] around opening of the anode electrode 8 at a symmetric position, and make the distribution of etching gas uniform.
[0031] The equipment of this example is used and they are the etching conditions CF 4. Flow rate 30sccm and H2 It is SiO2 at flow rate 70sccm, pressure 0.2Torr, and RF power 500W. It **********ed. Although etching processing was repeated and etching for a total of 30 minutes was performed, fluorocarbon was not deposited on the light-transmission aperture 12 at all.
[0032] The conventional dry etching system shown in drawing 3 is used, and they are the etching conditions CF 4 like the above. Flow rate 30sccm and H2 It is SiO2 at flow rate 70sccm, pressure 0.2Torr, and RF power 500W. It **********ed. When etching processing was performed for a total of 30 minutes like the above, fluorocarbon deposited 350A on the light-transmission aperture 12.
[0033] In the 1st above-mentioned example and the 2nd above-mentioned example, although explained

as what formed the light-transmission aperture for emission spectrum observation with the quartz, if this light-transmission aperture is formed with sapphire, the transparency aperture itself can prevent **********ing by the etching gas to spray.

[0034]

[Effect of the Invention] Since fluorocarbon does not deposit 350A on the light-transmission aperture for plasma luminescence detecting the terminal point of etching according to the dry etching method or dry etching system by this invention as explained above, the place which the intensity of the transmitted light cannot become weaker over a long period of time, can improve the operating ratio of dry etching, and contributes to reduction of the manufacturing cost of a semiconductor device is large.

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